LAWRENCE
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NATIONAL
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Fire Protection Program Manual

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Lawrence Livermore National Laboratory
Emergency Management Department

Fire Protection Program Manual

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PREFACE

This manual documents the Lawrence Livermore National Laboratory (LLNL) Fire Protection Program. Department of Energy (DOE) Orders 420.1B, Facility Safety, requires LLNL to have a comprehensive and effective fire protection program that protects LLNL personnel and property, the public and the environment. The manual provides LLNL and its facilities with general information and guidance for meeting DOE 420.1B requirements. The recommended readers for this manual are: fire protection officers, fire protection engineers, fire fighters, facility managers, directorate assurance managers, facility coordinators, and ES&H team members.

The Fire Protection Program Manual is best used as a reference manual. The manual contains a list of acronyms encountered in the document.

1.0 INTRODUCTION

1.1 Organization and Programs

Lawrence Livermore National Laboratory is owned by the Department of Energy (DOE) and is operated by the Lawrence Livermore National Security, LLC for DOE/NNSA. The DOE/NNSA Livermore
Site Operations Office (DOE-LSO) is the field organization responsible for the LLNL site.

The Laboratory was established in 1952 to conduct research on nuclear weapons. Currently,
LLNL is operating these major programs:

- Defense and Global Security
- Energy
- National Ignition Facility and Photon Sciences
- High Performance Computing
- Engineering
- Physical and Life Sciences

These programs perform research in chemistry and materials science, computer science and technology, biomedical sciences, engineering, and physics.

2.0 SITE DESCRIPTION

LLNL is operated and managed by Lawrence Livermore National Security, LLC (LLNS). LLNS is a private corporation composed of Bechtel National, the University of California, the Babcock & Wilcox Company, URS, Battelle, and the Texas A&M University System. Prior to LLNS assuming control of LLNL on October 1, 2007, LLNL was operated from its inception in 1952 through September 2007 solely by the University of California for the U.S. government.

LLNL is a premier research and development institution for science and technology applied to national security. It is responsible for ensuring that the nation's nuclear weapons remain safe, secure, and reliable. LLNL also applies its expertise to prevent the spread and use of weapons of mass destruction and strengthen homeland security.

LLNL's national security mission requires special multidisciplinary capabilities that are also used to pursue programs in advanced defense technologies, energy, environment, biosciences, and basic science to meet important national needs. These activities enhance the competencies needed for LLNL's defining national security mission.
The Laboratory serves as a resource to the U.S. government and is a partner with industry and academia. Safe, secure, and efficient operations and scientific and technical excellence in its programs are necessary to sustain public trust in the Laboratory.

The Laboratory staff consists of approximately 5,200 Career Laboratory employees as of December 1, 2011. Flex term, Post-Doc, Non-Career, and Supplemental Labor bring the Laboratory population to around 7,000.

LLNL is comprised of two non-contiguous sites – Livermore site and Site 300. Livermore site, sometimes known as Site 200, is located on a one-square-mile site in Livermore, CA. A larger (10 square mile) remote explosives/experimental testing site, Site 300, is situated 18 miles to the east with an approximate population of 200.

2.1 Physical Attributes of the Sites

LLNL consists of two sites, the main Laboratory site located in Livermore, California (Site 200) in Alameda County, and the Experimental Test Site (Site 300) located near Tracy, California, on the border between San Joaquin and Alameda counties. (See Figures 1.1, 1.2, and 1.3).

2.1.1 Site 200

The Livermore site is located approximately forty miles east of San Francisco in the Livermore valley in southern Alameda County, State of California. The downtown area of the City of Livermore lies about three miles to the west of the Livermore site. In addition to Livermore, notable urban areas to the west of LLNL are the cities of Pleasanton, Dublin, Danville, and San Ramon, and the densely-populated San Francisco Bay Area.

Urban areas lying in the general northerly direction from LLNL are the cities of Concord, Walnut Creek, Pittsburg, and Antioch; while Tracy, Manteca, Stockton, and Modesto are to the east. To the southwest lie the densely-populated cities of Santa Clara County, which include San Jose.

The Livermore site, which is roughly one square mile, is located in the southeastern part of the Livermore valley. The valley is situated in a section of the California coast range that lies between San Francisco Bay on the west and the northern San Joaquin valley to the east. The Livermore valley is primarily of low relief, although it does contain scattered groups of hills that rise from 300 to 600 meters above the valley floor.

Details on the geography, topography, demography, meteorology, natural phenomena, transportation systems, and utilities can be found in the Environmental Impact Statement/Environmental Impact Report for the Livermore site, the *Environmental Report (current version)* or the safety analysis reports.

Site 200 consists of 455 structures, providing approximately 6.7 million square feet of space, which can be further divided into 190 permanent buildings, 85 modular buildings, 90 trailers, 31 tents, and 59 other structures

2.1.2 Site 300

Site 300 is comprised of 7,000 acres in the foothills 18 miles southeast of Livermore (Site 200). The site is operated for the Weapons and Complex Integration Directorate and was established in 1955 as an explosives test site. In October 1955, the first outdoor explosives test was conducted at Building 801. There are approximately 200 employees (Laboratory and subcontractor) that report to Site 300 as their assigned work location.

The base mission of the site from its beginning in 1955 to what it is today has not changed to a large degree. Site 300 supports the Laboratory's nuclear weapons program by destructive tests of high explosives and other non-nuclear weapon components.

Several administrative and service buildings are clustered near the entrance to Site 300. Most non-programmatic functions are generally consolidated here at the General Services Area. The environmental test area is to the northeast. The area where high explosives are fabricated and test devices are assembled is to the north at the process and chemistry areas. Firing activities take place in the east and west firing areas. The separation of the firing areas from the process area and the General Services Area illustrates land-use compatibility considerations in site selections. The firing bunkers, where high explosives and other weapon components are detonated on open firing tables, are still farther north, separated from each other and well away from the boundaries of the site. Scattered throughout the site are earth-covered magazines for storage of high explosives, waste collection and treatment areas, and numerous storage buildings.

While non-programmatic functions have been generally consolidated in the General Services Area, certain facilities such as the weather station, power substation, and protective services communications facility are located strategically elsewhere for their special support functions.

Site 300 consists of 187 structures providing approximately 400,000 square feet of space which can be further divided into 90 permanent buildings, 25 modular buildings, 5 trailers, and 67 other structures.

3.0 FIRE PROTECTION POLICY

3.1 Department of Energy

DOE Order 420.1B, Attachment 1, Chapter II defines that the objectives of a comprehensive fire
protection program are to minimize:

a. Occurrence of a fire or related event;
b. Fires that cause an unacceptable onsite or offsite release of hazardous or radiological material that could impact the health and safety of employees, the public, or the environment;

c. Unacceptable interruption of vital DOE programs as a result of fire and related hazards;
d. Property loss from fire exceeding limits established by DOE;
e. Fire damage to critical process controls and safety class systems structures and components (as
f. Documented by appropriate safety analysis).

3.2 LLNL ES&H Policy

The Laboratory is committed to continual improvement in occupational health and safety performance as well as protecting individuals at the Laboratory, the public, and preventing property loss or damage using the LLNL Integrated Safety Management System. Safety and health take priority in the planning and execution of all work activities at the Laboratory.

In support of this policy, LLNL commits to:

- Take responsibility and be accountable for continuous improvement of safety and health performance at LLNL.
- Comply with applicable ES&H laws, regulations, and other requirements.
- Ensure that employees are physically and psychologically capable of performing their assigned duties by preventing injury and ill health.

3.3 LLNL Fire Protection Program Policy

The LLNL Fire Protection Program's policy is to implement 10CFR851 and DOE Order 420.1B and all other DOE prescribed fire protection codes and standards that are applicable to LLNL including those promulgated by the National Fire Protection Association (NFPA

The primary means of advising the Laboratory of the fire protection requirements is via Document 22.5 Fire of the ES&H Manual. This document gives an overview of the requirements, documents some of the more common requirements, refers readers to the Fire Protection Engineering Standards, references other sections of the ES&H Manual, and provides contacts for further questions.

The Fire Protection Engineering Standards provide the basis for the Fire Protection Program. Fire Protection Engineering Standard 1.0 *Fire Protection Engineering Mission Statement* describes the basics of the fire protection program, FPE Standard 1.2 *LLNL Fire Protection Program Criteria* contains a list of applicable DOE orders, codes and standards while FPE Standard 1.2.1 describes the code and standard adoption process for LLNL fire protection codes and standards. A complete description of the Fire Protection Engineering Standards is contained in Section 10.

There are a small set of Fire Protection Policies and Procedures issued under the Emergency Management Department banner. EMD Policy 100.00 is the Impairment Control of Critical Health and Safety Systems while EMD Policy 410.00 is the Hot Work Permit policy.

Fire Department Operational Policies and Procedures are now contained in the Alameda County Fire Department Official Action Guides. A set of Official Action Guides specific to LLNL are contained in Section 30 of those Guides.

3.4 Emergency Management Mission Statements

3.4.1 Emergency Response

The mission of the emergency response organization is to support Lawrence Livermore National Laboratory's national security mission by limiting the impact of fire, rescue, medical and hazardous material emergencies.

To meet this mission LLNL contracts with the Alameda County Fire Department to provide emergency response services for fire, emergency medical, hazardous materials, and technical rescue incidents.

3.4.2 Fire Protection Engineering Program

The mission of the fire protection engineering program is to assist the Laboratory staff in maintaining a fire safe working environment, which is in compliance with DOE and LLNL fire protection policies and applicable safety and fire protection laws, regulations and requirements.[1]

4.0 MANAGEMENT AND ADMINISTRATION

4.1 Management Responsibilities

LLNL's management and employee ES&H responsibilities are delineated in the LLNL ES&H Manual, Volumes 1 through 5. This on-line resource is available to all LLNL employees.

4.2 Fire Protection Organization Structures

Line management is responsible for facility and employee safety, including fire safety. The Emergency Management Department, under the Facilities and Infrastructure Directorate, is the parent organization for fire protection. The Fire Protection Division of Emergency Management is responsible for implementing the Laboratory's fire protection program. The Division contains the fire protection engineers, fire protection technicians, known as fire inspectors, and the Fire Marshal who is the division leader and Laboratory's Authority Having Jurisdiction for fire protection[2].

[1] LLNL Fire Protection Engineering Standard, 1.0/Rev. 5, September 15, 2011.

[2] NNSA-LSO has formally delegated determination of equivalencies to the Fire Marshal who is the Authority Having Jurisdiction for matters concerning fire protection codes and standards interpretation, application, and evaluations of compliance.

The fire protection engineers (FPEs) primarily deliver their services to the Laboratory Programs by participating as members of the ES&H Teams. The ES&H Teams provides expertise, guidance, and services needed by line managers in all health and safety matters. There are three FPEs with one assigned to Team 1 responsible for nuclear facilities, one assigned to Team 2 primarily responsible for the NIF Principle Directorate, and one assigned to Team 2 for all other facilities. While reporting to the Fire Marshal the FPEs work via the ES&H Teams to keep abreast of program changes, review Integrated Work Sheets, review plans for construction, perform tri-annual fire protection assessments and Fire Hazards Analyses of nuclear facilities and certain facilities with unique fire protection issues.

The Fire Inspectors perform several key fire protection functions. They issue Hot Work Permits, perform water based suppression system impairments, and perform monthly inspections of: fire extinguishers, water suppression system valves, certain battery powered emergency lights, and Automated External Defibrillators (AED). They also perform certain fire extinguisher annual maintenance while arranging for most extinguisher testing from a local fire extinguisher contractor.

4.3 Fire Department

LLNL contracts with the Alameda County Fire Department (ACFD) to provide a resident emergency response capability at both LLNL sites. The Fire Department is responsible for initial response to all non-security emergencies on or adjacent to LLNL property.

LLNL also contracts with ACFD for the services of the Alameda County Regional Communications Center (ACRECC) for the following 24 hour services:

a. Answering emergency telephone calls.
b. Dispatching emergency fire and emergency medical apparatus via station alerting systems and radio for LLNL and Sandia National Laboratory.
c. Monitoring and responding to active alarms received over the FEVA system.
d. Making emergency and non emergency announcements via the FEVA system
e. Tracking emergency and non-emergency response resources via radio and telephone.
f. Providing emergency pager notification for deaf employees.
g. Making Emergency Alert System announcements for Site 200.
h. Participating in facility and site drills and exercises as required by DOE Order 151.1.C
i. Coordinating emergency response with LLNL and Sandia National Laboratory Protective Force personnel.

4.4 ES&H Teams

Two ES&H Teams provide environmental, safety and health support to LLNL programs. Each ES&H team has at least one professional fire protection engineer assigned, who provides fire protection engineering support.

4.5 Alarms Division

The Emergency Management Department's Alarms Division supports the LLNL Fire Protection Program through operation and maintenance of the site-wide fire and emergency voice alarm system utility as well as providing inspection, testing, and maintenance of individual building fire and suppression systems. The Alarms Division uses the provisions of NFPA 72 *National Fire Alarm and Signaling Code* and NFPA 25 *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems* to establish their inspection, testing, and repair program.

4.6 Fire Protection Personnel Professional Qualifications

DOE Order 420.1B requires that contractors have a qualified and trained fire protection staff. The LLNL fire protection staff meets these requirements by a combination of education, training, experience in fire protection, knowledge of DOE requirements, and in some cases, licensure. A Qualification Card is maintained for each FPE and Fire Inspector.

4.6.1 Fire Department Personnel

The Statement of Services for the Fire Department contract with the Alameda County Fire Department contains minimum professional standards for fire fighters and fire officers. Those standards are:

Firefighters
- State Certified Firefighter I
- State Certified Hazardous Materials Technician (Livermore Station Only)
- State Paramedic License or Emergency Medical Technician I Certification
- California Class B Drivers License
- Department of Energy "Q" security clearance
- LLNL Firefighter/Driver Operator Task Book

Driver Operators
- Meet the requirements for firefighter, and
- Subcontractor Driver Operator Requirements
- LLNL Firefighter/Driver Operator Task Book

Captains
- Meet the requirements for firefighter, and Subcontractor's Fire Officer Requirements
- LLNL Captain/Chief Officer Task Book

Battalion Chiefs
- Subcontractor Chief Officer Requirements
- Hazardous Material Incident Commander Certification
- LLNL Captain/Chief Officer Task Book

4.6.2 Fire Protection Engineers

The fire protection engineering staff shall be made up of qualified fire protection engineers. LLNL's staff fire protection engineers must possess one of the following qualifications:

- Meet the qualifications for Member Grade in the Society of Fire Protection Engineers
- Be a registered professional fire protection engineer
- Meet the Fire Protection Engineer requirements as defined by the Office of Personnel Management
- Meet the Fire Protection Engineer requirements as defined by DOE-STD-1137-2000, Fire Protection Engineering Functional Area Qualification Standard

In addition, each fire protection engineer must possess the following qualifications:

- Successfully completed an NFPA Life Safety Code Seminar within last 4 years
- Successfully completed an NFPA Fire Alarm Code Seminar within last 4 years
- Successfully completed an NFPA Sprinkler System Seminar within last 4 years
- Successfully completed an NFPA Sprinkler Maintenance Seminar within last 4 years
- Be conversant with the requirement of the International Building Code
- Be conversant with the requirements of the NFPA Fire Code

4.6.3 Fire Inspectors

The LLNL fire inspectors must meet the following qualifications:

- Understand and apply the provisions of NFPA 51B *Standard for Fire Prevention during Welding, Cutting, and Other Hot Work.*
- Understand and apply the provisions of NFPA 10 *Standard for Portable Fire Extinguishers.*
- Successfully completed Fire Extinguisher Training
- Successfully completed Hot Work Permit requirements review
- Successfully completed the NFPA Means of Egress Short Course
- Be a licensed fire extinguisher technician or work under the guidance of a licensed technician.

4.6.4 Alarm Division

The Alarms division personnel installing, inspecting, and testing the LLNL Fire and Emergency Voice Alarm System are required to have the following qualifications:

- License electrician
- Life Safety Certification added to electrician license
- Siemen's certification for alarm systems installed at LLNL
- Manufacturer training for emergency voice systems installed at LLNL
- Successfully completed an NFPA Life Safety Code Seminar within last 4 years
- Successfully completed an NFPA Fire Alarm Code Seminar within last 4 years
- Successfully completed an NFPA Sprinkler Maintenance Seminar within last 4 years
- Successfully completed an NFPA National Electrical Code Seminar within last 4

years
- Successfully completed an NFPA Sprinkler System Seminar within last 4 years
- Successfully completed an NFPA 70E Seminar within last 4 years

5.0 SITE UTILITIES

5.1 Water Supply

5.1.1 Hetch Hetchy

Until 1960, LLNL used treated well water to meet its needs. Since 1960, the main water supply has been purchased from the City of San Francisco Hetch Hetchy Aqueduct system via the Mocho Shaft located ~6 miles south of LLNL. This domestic water is delivered to LLNL under gravity flow from three water storage tanks located on Sandia National Laboratory/CA property. The Sandia water storage tank capacity is 1.5 million gallons.

5.1.2 Zone 7 Water

If Hetch Hetchy water quality or quantity becomes a problem, a backup water resource exists. A LLNL contract with the Alameda County Flood and Water Conservation District, Zone 7 supplies water through the California Water Service Company. During emergencies, Zone 7 water is pumped into the LLNL distribution grid at a pumping station at LLNL's north boundary.

5.1.3 Emergency Storage Reservoirs

In addition to the main water storage facility, one emergency storage reservoir is available; the reservoir is the LLNL centrally located water retention basin. If necessary, a fire truck could pump these waters directly into the distribution grid.

5.1.4 LLNL Domestic Fire Water

Obviously, a reliable water supply is paramount for LLNL fire protection. DOE requirements are stringent regarding fire water availability and distribution. The LLNL water resource meets DOE and NFPA water requirements for both available volume and distribution.

5.1.5 Domestic Water Usage

Domestic Water Usage	
Major Uses	**Minor Uses**
fire protection	drinking
Industrial cooling processes	manufacturing
sanitary systems	washing
irrigation	system filters
	boilers

5.1.6 Consumption

Metered totals of the Livermore site include water used at Sandia which is estimated 13.5 to 21.2 percent of the total combined usage. LLNL average annual water consumption is estimated at 241 million gallons. Of that, the average annual Zone 7 purchases are 20 million gallons. The combined LLNL-Sandia annual consumption for the past six years averages 292 million gallons.

5.1.7 Distribution

Water distribution is accomplished by gravity flow from the Sandia Hill storage tanks via one 14-inch and one 16-inch tie into an LLNL 14-inch water main on the south side of the LLNL grid. Water mains are on most streets in developed areas. The minimum main size is 8 inches. Hydrants are located every 300 to 500-feet within this system.

5.1.8 Water Supply Availability

Water Supply Availability		
Source	**Duration**	
	5 Hours	7 Hours
Storage Tanks (Kgal)	1,500	1,500
Zone 7 Pumps (Kgal)	600	840
Hetch Hetchy Pumps (Kgal)	570	800
Total Available (Kgal)	2,670	3,140
Flow until Depletion	8,900 gpm	7,476 gpm

5.1.9 Site 300 Water Supply

The present Site 300 water supply comes from a number of wells and associated storage tanks located throughout the site. These tanks range from 63,000 to 165,000 gallons capacity. An additional connection to the Hetch Hetchy aqueduct via the Thomas Shaft, south of the site adds reliability and capacity to improve the Site 300 water supply.

5.2 LLNL Electric Power

Electric power has a strong impact on LLNL fire protection. Electrically powered alarms on fire protection and detection equipment alert facility residents and the fire department of possible fire occurrences. DOE regulations and National Fire Protection Association (NFPA) codes & standards require a reliable electric service including generator backup for special-use LLNL facilities.

5.2.1 Site 200 Electric Utility System

Site 200 is served by both Pacific Gas & Electric Company (PG&E) and Western Area Power Administration at 115kV through parallel-operated transmission lines. There are two Main-Power 115/13.8kV Substations connected to the transmission lines: the Western Livermore Substation (WLS) and the LLNL U-424 Substation. The WLS consists of one 100MVA 115-13.8kV step-down transformer and the U-424 Substation consists of two

100MVA 115-13.8kV step-down transformers. There are seven 13.8kV load-grid switchgear (LGS) units installed strategically throughout the Site served by both Main-Power Substations. An LGS is an outdoor metal-clad switchgear line-up consisting of a main-tie-main bus configuration. The north-bus of each LGS is fed directly from the WLS via dedicated express feeders and the south-bus of each LGS is fed directly from the U-424 Substation via dedicated express feeders. Each LGS has a loss-of-incoming-power automatic transfer scheme that will transfer load to the healthy source if one of the incoming power sources is lost. Each LGS has up to eight underground load feeders that connect to other LGS load feeders through load-sectionalizing switches in an open-loop configuration. Distribution transformers are connected to the LGS load feeders and step down the voltage from 13.8kV to the appropriate building utilization voltage (typically 480V).

5.2.2 Site 300 Electric Utility System

Site 300 is served by PG&E at 115kV through a radial transmission line (there is no alternate transmission source). There are two Main-Power 115/12kV Substations connected to the transmission line: the LLNL U-846 Substation and the LLNL ATA Substation. The ATA Substation is a back-up to the U-846 Substation. There is one 20MVA 115-12kV step-down transformer at the U-846 Substation and one 20MVA 115-12kV step-down transformer at the ATA Substation. The ATA Substation is connected to the U-846 Substation by a 12kV overhead tie-line through a normally open load-sectionalizing switch. There are four 12kV overhead load feeders extending from the U-846 Substation that are connected to each other through load-sectionalizing switches in an open-loop configuration. Distribution transformers are connected to the load feeders and step down the voltage from 12kV to the appropriate building utilization voltage (typically 480V).

5.3 Natural Gas

LLNL uses gas purchased from Pacific Gas and Electric.

5.3.1 Gas Distribution

Gas is supplied from the main meter station at southern South Gate Drive and is distributed at 8 psig via an underground grid system to most LLNL developed areas. On average, LLNL uses 1.3 Kscf / day, with a peak of 2.1 Kscf / day.

6.0 Fire Department Operations

6.1 Scope of Services

The subcontract with the Alameda County Fire Department (ACFD) provides that the subcontractor will provide personnel and management functions for the emergency response services portion of the fire protection and emergency management programs at LLNL. Services are to include: pre-incident planning, assigned fire prevention activities, emergency medical services, hazardous materials emergency response, maintenance and testing of fire department equipment, personnel training and drills as necessary to insure proper performance.

6.2 Policies and Procedures

The ACFD has a set of operational policies and procedures known as Official Action Guides (OAGs). OAGs in the 30.100 series contain topics that are specific to LLNL. LLNL Fire Department policies and procedures that existed prior to the subcontract with ACFD have either been incorporated into the ACFD OAGs or ACFD had equivalent OAGs in place.

7.0 RELATIONSHIPS WITH EXTERNAL AGENCIES

7.1 National Fire Protection Association Relationships

LLNL fire protection staff provides technical assistance to DOE through their service on NFPA Technical Committees. These committee assignments contribute to the development of DOE prescribed codes and standards. Examples of NFPA committee assignments include the following:

- Safety to Life
- Laboratories using Chemicals
- Fire Code

7.2 DOE Relationships

LLNL fire protection program staff serves on the DOE fire safety committee.

7.3 Mutual Aid Agreements

Formal mutual aid agreements exist between the LLNL other local fire protection agencies. These agreements provide for fire protection support among signatory agencies as needed during fires and other emergencies. The current list of agreements is as follows:

- Automatic Aid with the Alameda County Fire Department
- Automatic Aid with the Livermore-Pleasanton Fire Department
- Alameda County Mutual Aid Agreement
- Mutual Threat Zone Agreement with Cal Fire for S-300
- Mutual Assistance Interconnection of Water Systems with City of Livermore

LLNL meets its obligations under these mutual aid agreements through its subcontractor, the Alameda County Fire Department.

8.0 FIRE PROTECTION ENGINEERING PROGRAM SPECIFIC

8.1 Fire Protection Criteria/Requirements

The following documents are the codes of record for the Laboratory in the area of Fire Protection, and serve as the baseline criteria of the LLNL Fire Protection Program.

- National Fire Codes, published by the National Fire Protection Association (specific editions identified and updated annually).
- CFR 1910, Subpart E and L.

- CFR 1926, Subpart F.
- California Building Code unless superseded by the Life Safety Code
- California Fire Code unless superseded by NFPA 1, Fire Code
- DOE Order 420.1B, CRD Chapter 2, *Fire Protection*
- Factory Mutual Data Sheet #7-98, *Hydraulic Fluids.*
- DOE-HDBK-1081-94, *Primer on Spontaneous Heating and Pyrophoricity.*

In addition to the fire protection codes of record, there are a number of additional fire safety reference and guidance documents that support the Laboratory's fire protection program.

- DOE-STD-1066-99, *Fire Protection Design Criteria.*
- DOE-STD-1088-95, *Fire Protection for Relocatable Structures.*
- National Fire Protection Association (NFPA) Handbooks.
- Factory Mutual Engineering, *Loss Prevention Data Sheets.*
- GE Global Asset Protection Services. *Guidelines for Loss Prevention and Control.*
- Society of Fire Protection Engineers (SFPE) Handbook.
- Local and State fire protection criteria, as applicable.
- American Petroleum Institute (API) Guidelines.
- National Fire Protection Association (NFPA) guides, manuals and recommended practices.
- Product Directories of Underwriters Laboratories (UL.)
- Factory Mutual Research Corporation Approval Guide (FM).

8.2 Technical Library

The Fire Protection Division maintains a current technical library that includes, as a minimum, the above documents, plus the DOE Fire Protection Resource Manual.

8.3 Fire Investigations and Reports

DOE Order 232.2 Occurrence Reporting and Processing of Operations Information prescribes procedures for LLNL to make appropriate notifications and perform analysis and reporting of specific occurrences, incidents, and accidents (including fires). LLNL procedure PRO-082 Reporting Occurrences to DOE describes the process used by LLNL to meet the DOE Order. While facility personnel are to report occurrences within their facilities, the Fire Marshal reports items to the Occurrence Reporting Officer that fall below the DOE reporting thresholds. These reports are due quarterly.

The Fire Protection Division maintains files on all major incidents involving their organization. These files are located in the Fire Protection Division office, Building 323.

All field reporting of fire incidents is done in accordance with the California All Incident Reporting System (CAIRS) and the National Fire Incident Reporting System (NFIRS) via the ACFD Records Management System section of their Computer Aided Dispatch (CAD) system.

Prior to the contract with ACFD, the LLNL Fire Department maintained a similar system as part of the LLNL CAD system. Copies of all field incident reports are available to authorized requesters.

8.4 Annual Reports

LLNL submits fire protection information to the DOE Annual Fire Protection Summary database, an electronic reporting tool sponsored by DOE Office of Health, Safety, and Security. The summary includes these core topics:

- Summary of fire loss damage
- Non-fire incidents actuating automatic fire suppression systems
- Halon reduction activities
- Fire protection inspection, testing and maintenance activities
- Fire department response statistics
- Recurring fire protection program costs

8.5 Fire Safety Practices and Procedures

ES&H Manual Document 22.5, "FIRE" contains the Laboratory's basic fire safety practices and procedures. The ES&H Manual is available on-line. A set of Fire Protection Engineering Standards is maintained by the Fire Marshal and is published on the web via the Emergency Management Department web site.

9.0 Fire Protection Engineering Facility Specific

9.1 Design and Modification Review

9.1.1 Design responsibility

Document 42.1, Management of Facility Design and Construction in the ES&H Manual states that facility design is a collaborative effort that involves the AO requesting the design, facility design professionals in several engineering disciplines, health and safety specialists and analysts (which includes fire protection), environmental protection analysts, and security organization specialists. Further, document 42.1 specifies that Authorities Having Jurisdiction (AHJs) are authorized as the final arbiters of design issues. One of those AHJs is the Fire Marshal. The Fire Marshal or his authorized representative is required to sign all design drawings.

9.1.2 Project Management Engineering & Construction Department responsibility

The Project Management Engineering & Construction Department (PMEC), which is responsible for facility design and modification, has developed procedures for incorporating fire protection review in addition to any review via the ES&H Team. This is a review of engineering documents for new construction or for existing facilities. The Fire Marshal or his authorized representative must sign approval of all new construction projects.

9.1.3 Maintenance & Utilities Services Department responsibility

The Maintenance & Utilities Services Department (MUSD) is responsible for the

ongoing maintenance of facilities and utilities at LLNL. This also includes minor modifications of systems such as the water supply utility, which may impact fire protection. All work done by MUSD is controlled by the LLNL Institution-Wide Work Planning and Control Process as described in ES&H Manual Document 2.2. All work requires some form of review which includes review by fire protection engineers as part of the ES&H review of the Integrated Work Sheet (IWS) which is required for all work activity.

9.1.4 Fire Protection Engineer responsibility

In addition to any IWS review through the ES&H Team, MUSD Operations Procedure PROC-OPS-0002 Building Fire Sprinkler System Outage Permits**,** requires that a fire protection engineer approve, in writing, all changes or modifications to sprinkler system and that impairment of the system will be with the approval of the Fire Marshal.

Changes to the level of fire protection provided by the building Fire and Emergency Voice Alarm System require approval by the fire protection engineer assigned to that building. The Alarms Division will not modify the protection level of a system unless there is written documentation from the fire protection engineer or Fire Marshal. All new fire protection systems must be reviewed and approved by a fire protection engineer or the Fire Marshal.

9.1.5 Work Request procedure

All work follows the LLNL Institution-Wide Work Planning and Control Process. That process requires ES&H review of the IWS for each job. Fire protection engineering is a key portion of that work review process. Work is classified into Work Authorization Levels (WALs) which determines the level and rigor of the review. ES&H Manual Document 2.2 describes this process in detail.

9.1.6 Facility and Equipment Design Specifications and Standards

LLNL's Engineering and Construction Department has primary responsibility for the development and publication of facilities specifications and standards. Fire protection engineers review proposed Plant Engineering Standards as well as any specifications that are developed for specific construction or renovation projects.

In addition to the aforementioned institutional standards and specifications, the Fire Protection Division has developed a series of Fire Protection Engineering Standards. These standards are used by the ES&H teams, fire protection engineers and other appropriate individuals to provide a consistent approach to common fire protection problems at LLNL.

Many of these Fire Protection Engineering Standards have been incorporated into the institutional standards developed by the PMEC. These standards are summarized in Chapter 8 of this manual.

9.2 Equipment Procurement Approval

LLNL controls the procurement and issue of fire safety related equipment and materials by the following method:

- Fire Protection and Procurement have established a list of fire safety-related equipment and materials requiring approval and sign-off.
- The Procurement Department's requisition screening desk uses this list for screening requisitions.
- Requisitions for items on this list are forwarded to the Fire Marshal for approval and sign-off.

The current list of "controlled" items requiring Fire Marshal approval includes:

1. Fire alarm equipment
2. Fire sprinklers
3. Exit and Emergency Lights
4. Fabric or carpet wall covering
5. High-Density Polyethylene and Polypropylene wall or ceiling finish
6. Ceiling tiles

9.3 Fire Protection Systems Testing/Maintenance

LLNL policy requires organizations to maintain equipment in a manner, which promotes operational effectiveness, personnel health, and safety, environmental protection, property protection, and cost effectiveness. This policy incorporates fire protection equipment.

9.3.1 Emergency Management Department Alarms Division responsibility

The Emergency Management Department Alarms Division exercises primary responsibility for inspection, testing, and maintenance of fire protection equipment. The Alarms Division accomplishes this responsibility according to applicable NFPA codes and standards. The Alarms Division maintains inspection, testing, and maintenance procedures in Building 324.

9.3.2 Emergency Management Department Fire Protection Division responsibility

In addition to the testing and maintenance done by the Alarms Group, the Emergency Management Department performs periodic testing and inspection of the following:

- Automatic sprinkler system valves
- Fire extinguishers
- Fire hydrants
- Emergency lights (battery powered)

These procedures are available through the Fire Marshal.

9.4 Corrective Action Tracking System

The LLNL Issue Tracking System (ITS) was developed to assure LLNL senior managers that ES&H corrective actions were being met in a uniform, consistent manner. ITS is a system which provides a logical and convenient mechanism for finding, tracking, verifying, and assessing deficiencies found during ES&H compliance inspections and appraisals. Institutional Procedure PRO-0042 Issues and Corrective Action Management describes the Laboratory's issues tracking and corrective action management system.

9.5 Property Loss Criteria

To minimize property losses due to fire, LLNL maintains an improved risk level of fire protection by:

- Designing facilities using fire-resistant materials or those of limited combustibility by us sing building materials and components that have been tested and approved by a nationally recognized testing laboratory, when applicable.
- Installing automatic fire protection systems in all facilities over 5,000 sq. ft. or where a fire could result in a monetary loss of $1 million or more.
- Conducting routine fire protection assessments to identify fire hazards and areas that are not sufficiently protected
- Conducting periodic inspections, tests, and maintenance of fire and life safety equipment and systems to ensure that they operate properly

A more detailed discussion of the Laboratory's improved risk fire protection program can be found in LLNL Fire Protection Engineering Standard 1.3**,** LLNL *Improved* Risk *Fire Protection Program*. LLNL Fire Protection Engineering Standard

9.6 Fire Protection System Operability

Periodic inspections and tests in accordance with applicable NFPA codes or standards to meet the DOE criteria to confirm that these fire protection features are operable.

If critical health and safety protection systems, including fire protection systems, are to be inoperable for a significant period of time, appropriate compensatory measures will be implemented until operability is restored. FPE Standard 1.6 *Interim Fire Protection or Life Safety Measures* describes the compensatory measures that can be used.

9.6.1 Sprinkler Systems

Sprinkler systems are inspected and test in accordance with the provisions of NFPA 25 *Standard for the Inspection, Testing, and Maintenance of Water Based Fire Protection Systems*.

9.6.2 Standpipe and Manual Water Spray Systems

These systems are inspected and test in accordance with the provisions of NFPA 25 *Standard for the Inspection, Testing, and Maintenance of Water Based Fire Protection Systems*. The inspection, testing, and maintenance required by NFPA 25 is performed by LLNL Alarms Division and the MUSD.

9.6.3 Chemical Systems

Currently, the only chemical fire protection systems at LLNL are installed in the kitchen areas of the cafeterias. These systems are inspected and tested in accordance with the provisions of NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations*. The service required by NFPA 96 is performed by outside contractors.

9.6.4 High Expansion Foam System

These systems are inspected, tested, and maintained in accordance with NFPA 11,

Standard for Low-, Medium-, and High-Expansion Foam. The provisions of NFPA 11 are met by a combination of work by MUSD and outside contractors.

9.6.5 Carbon Dioxide Extinguishing System

These systems are inspected, tested, and maintained in accordance with NFPA 12 *Standard on Carbon Dioxide Extinguishing Systems*. The service required by NFPA 12 is performed by outside contractors.

9.6.6 Clean Agent Extinguishing Systems (high pressure)

These systems are inspected, tested, and maintained in accordance with NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems. The service required by NFPA 2001 is performed by outside contractors.

9.6.7 Tank Water Supply System and Fire Service Mains

These items are installed and maintained in accordance with two NFPA standards; NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances* and NFPA 22,*Standard for Water Tanks for Private Fire Protection*. The provisions of these standards are met by a combination of work by MUSD and outside contractors.

9.6.8 Fire Alarm System and Central Monitoring (Fire) System

These systems are inspected, tested, and maintained in accordance with NFPA 72 *National Fire Alarm and Signaling Code*. The inspection, testing and maintenance is performed by the EMD Alarms Division. The EMD Alarms Division is listed by Underwriters Laboratories.

9.6.9 Fire Doors, Windows and Fire Dampers

These components, where required, are governed by NFPA 80 *Standard for Fire Doors and Other Opening Protectives.* Inspection and testing of fire doors is conducted on a scheduled basis in nuclear facilities and in NIF. Inspection and testing of fire doors in other facilities is on a period basis. The Alarms Division performs inspection and test of fire doors that are held open by automatic release devices as part of their fire alarm system testing.

9.6.10 Penetrations in Fire Barriers

Penetrations of required fire barriers a required to be protected in accordance with Chapter 8 of NFPA 101 *Life Safety Code*.

9.6.11 Exit and Emergency Illumination

Required exit and emergency illumination are inspected and tested in accordance with NFPA 101 *Life Safety C*ode and are considered operational when: the light fixtures are installed, powered, and operable, there is power available to charge the batteries (if so equipped), and any required batteries are charged to at least 90% of the required electrical charge.

10.0 FIRE PROTECTION ENGINEERING STANDARDS

Fire Protection Engineering Standards provide the basis for the Fire Protection Program by stating the program goals, identifying program mission, identifying applicable codes and standards, and giving specific direction on specific topics when the base codes and standards need interpretation or application guidance. The following is a list of the FPE Standards.

10.1 Administrative Policy and Procedures

1.0 Fire Protection Engineering-Mission Statement
1.1 Fire Protection Exemption and Equivalency Requests
1.1.1 Exemption and Equivalency Tracking
1.2.1 Adoption of Fire Protection Codes and Standards
1.2 LLNL Fire Protection Program Criteria
1.3 LLNL Improved Risk Fire Protection Program
1.5 Hot Work Permits – Fire Watch Duties
1.6 Interim Fire Protection or Life Safety Measures

10.2 Protection Systems

2.0 Standardization of Automatic Fire Protection Systems
2.1.2 Carbon Dioxide System Safety Calculation
2.3.0.1 Preaction Automatic Sprinkler Systems – General Guidelines
2.3.0.2 Wet Pipe Sprinkler Systems
2.3.1 Evaluating Existing Automatic Sprinkler Installations
2.3.2 Automatic Sprinklers for Exposure Protection
2.3.3 Quick Response Automatic Sprinklers
2.4.1 Medium and High-Expansion Foam Systems
2.5.0 Installation of Dry Chemical Systems – General Guidelines
2.6.0 Installation of INERGENSystems – General Guidelines
2.6.1 Protection of Sub-floors with INERGEN
2.7.0 Water Mist Fire Protection Systems – General Guidelines

10.3 Specific Hazards

3.1 Fire Protection - Laboratory Hood and Duct Systems
3.2 Hazardous Materials Storage Lockers
3.3 Outdoor Transformers
3.4 Protection of Automated Information Storage Systems

10.4 Safety to Life

4.1 Corridor Widths
4.2 Locking Devices - Security Vaults and Vault Type Rooms
4.3 Emergency Lighting
4.4 Means of Egress - Fenced Enclosures

10.5 Facilities - General

5.1 Emergency Operations Considerations - LLNL Facilities

5.2 Fuel Load/Fire Duration Guidelines
5.2.1 Calculation of Fuel Loads
5.2.2 Calculation of Fuel Loads WCI/NMTP Superblock Procedure
5.3 Fire Hazards Analysis
5.3.1 Review of Fire Hazard Analyses
5.5 Smoke Control
5.6 Estimating Building Values
5.7 Fire Protection for Relocatable Structures
5.8 Fire Protection Engineering Facility Assessment Program

10.6 Fire Detection Systems

6.1 Smoke Detection – Occupancy Based Requirements
6.2 Employee Alarm Systems
6.3 Fire Alarm Systems – Notification Appliances

10.7 Specific Occupancy Standards

7.1 Information Technology Equipment Rooms
7.2 Physics/ Applied Science Laboratories
7.3 Chemistry Laboratories

10.8 Portable Fire Extinguishers

8.2 Managed Phase Out - Halon 1211 Portable Fire Extinguishers
8.3 Portable Fire Extinguisher Service Request Procedures

10.9 Construction

9.1 Gas Cylinder Separation Barriers
9.2 Acceptability of Non – Tested Firestop Systems
9.3 Roofing Operations -- Withdrawn
9.4 Fire Door Inspection & Functional Testing
9.5 Fire Barrier/Fire Wall Inspection Procedure

11.0 ENVIRONMENTAL/PUBLIC PROTECTION

11.1 Operational and Facility Safety Plans

When the work planning process (see ES&H Manual Document 2.23 LLNL Institution-Wide Work Planning and Control Process) indicates the need for a safety plan, one of two types of safety plans are prepared: Facility Safety Plans (FSP's) or Integration Work Sheets with Safety Plans (IWS with SP). These plans govern work performed in LLNL facilities. ES&H Manual Document 3.3**,** Facility Safety Plans and Integration Work Sheets with Safety Plans provides the guidelines and controls for FSP's and IWS's with SP's. This guidance is available on-line. The primary purposes of a FSP and IWS with SP are to:

1. Identify the individuals responsible for implementing safe operations
2. Address ES&H concerns associated with a specific activity (IWS with SP) or all activities (FSP)

3. Describe how such activities will be controlled to comply with LLNL's ES&H policies and objectives

The ES&H teams, the Emergency Management Department, and other interested parties have access to these safety procedures through LLNL's electronic information exchange network. The Emergency Management Department is included on the standard distribution list of all Facility Safety Plans (FSP's). Copies of FSP's are maintained in the Emergency Management Department's Building Files.

11.2 Safety Analysis Reports

LLNL policy, through ES&H Manual Document 3.1 Nonnuclear Safety Basis Program states that any facility having a hazard above Light Science and Industry category requires a hazards analysis. ES&H Manual Document 51.1 Documented Safety Analysis Program provides the overarching plan for documenting the safety basis for Hazard Category 2 and 3 nuclear facilities.

Each facility associate director is responsible for the preparation and independent review of safety analyses. Safety analysis documents for new facilities and for major physical or operational changes in existing facilities must be submitted to DOE for review and/or approval before starting operations. In addition, safety analyses for nonnuclear facilities require a documented review at least every 3 years. Nuclear facilities are required to update their SARs annually. Fire protection is an element included in a safety analysis.

The Fire Hazards Analysis is a corollary document to the Documented Safety Analysis (DSA). Changes in the DSA, which is revised annually, are reflected in an updated FHA or in a memo stating that the DSA changes do not affect the FHA analysis.

12.0 Facility Assessment and Appraisal Program

12.1 LLNL Fire Protection Assessment Program

ES&H Manual Document 22.5, "Fire" and FPE Standard 5.8 FPE Facility Assessment Program describe the LLNL fire protection assessment program. The Program is divided into 3 levels depending upon the hazards and maximum possible fire loss (MPFL) present in the facility.

12.1.1 Fire Hazards Analysis (FHA)

This is a detailed fire protection assessment of a facility. The purpose of an FHA is to comprehensively and qualitatively assess the risk from fire within the individual fire areas to determine whether the DOE and LLNL fire protection objectives are met. The FHA is documented in accordance with LLNL Fire Protection Engineering Standard 5.3, *Fire Hazards Analysis*. FHAs are performed every three years.

An FHA is required for all nuclear facilities (regardless of MPFL), all significant new facilities, and two special facilities, B-368 and B-581.

12.1.2 Fire Protection Assessments (FPA)

A Fire Protection Assessment is a detailed evaluation of the fire protection and life safety aspects of significant facilities or facilities not qualifying for an FHA. FPAs are less rigorous than an FHA, and assess fewer elements of a facilities overall fire protection program. Facility Fire Protection Assessments are conducted in accordance with LLNL Fire Protection Engineering Standard 5.8 *Fire Protection Engineering Facility Assessment Program.* All non-nuclear facilities with an MPFL of at least $25M are required to have a Facility Fire Protection Assessment. FPAs are conducted every three years.

12.1.3 Life Safety Review Checklist (LSRC)

A Life Safety Review Checklist are required for all facilities that have a gross area exceeding 1,000 ft^2 and have an MPFL less than $25M. LSRCs are a quick review of key fire protection aspects of the facility. LLSRCs are required every 3 years. Facilities with a gross area less than 1,000 ft^2 or facilities that have been declared as Cold and Dark or firm targets for Cold and Dark do not require any type of fire protection assessment.

12.2 Documentation and Tracking of Deficiencies

When deficiencies are noted during an assessment (FHA, FPA, or LSRC) they are reported to the appropriate Directorate or PAD Assurance Manager, entered into the Issues Tracking System (ITS) as required by PRO-0042 Issues and Corrective Action Management. The ITS system tracks all compliance issues, including fire protection deficiencies, until their resolution.

12.3 Fire Protection Exemption or Equivalency Requests

Laboratory operations are designed to comply with Contract requirements; LLNL internal policies, procedures, and standards; federal, state, and local regulations; and other codes of record. However, there may be occasions when a specific work activity or facility requires a deviation from these established requirements. This written approval can take two forms:

12.3.1 Exemption

An exemption is written authority to deviate from a requirement in a DOE Order or referenced code or standard. Exemptions shall be processed in accordance with Fire Protection Engineering Standard 1.1. Exemptions must be approved by DOE.

12.3.2 Equivalency

An equivalency is an approved alternate means of satisfying the technical provisions of fire protection code or standard. Fire Protection equivalencies are to be processed in accordance with LLNL Fire Protection Engineering Standard 1.1. DOE has granted LLNL's Fire Marshal limited authority to grant equivalencies. Copies of all LLNL fire protection exemptions and/or equivalency requests are maintained in per the provisions of Fire Protection Engineering Standard 1.1.1.